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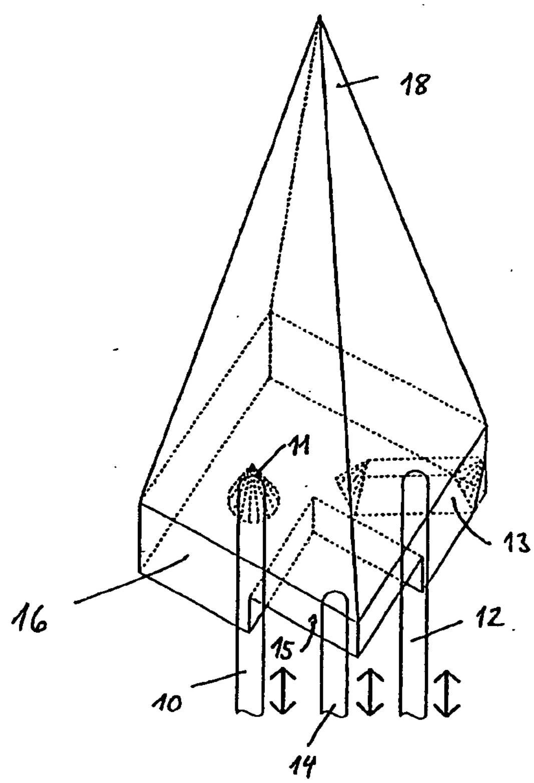
(54) Title: TEST SYSTEM FOR EQUIPPED AND UNEQUIPPED PRINTED CIRCUIT BOARDS

(57) Abstract

A device for testing substantially flat circuit carriers or printed circuit boards which are unequipped or which are equipped with electronic components comprises a contact connection device having a plurality of test needles, each test needle being provided in accordance with the invention with its own motor drive for setting the position of the tip of the test needle at any points of a three-dimensional portion of space at the contact connection device ("dancing needles"). For this purpose each test needle is disposed in a currently preferred embodiment on its own platform which is in the form of a wobble plate and the position of which can be adjusted in space by motor.



Test system for equipped and unequipped printed circuit boards

The present invention relates to a device for testing substantially flat circuit carriers (printed circuit boards/ceramic substrates, etc.) which are unequipped or which are equipped with electronic components, having at least one connection device (adapter) which is necessary for adaptation to the test sample and which connects a plurality of connection points present in the device to a plurality of contact points, i.e. test points, disposed in a geometrically variable manner depending on the test sample.

In the past unequipped printed circuit boards were frequently tested with respect to their regular functioning by means of a test probe adapter for example connecting all the test points of the test sample which frequently were disposed irregularly to the regularly formed contacts of the contact point grid of the computer-controller printed circuit board test apparatus. Thus each test point was tested in a computer-controlled manner with respect to all the others in order to see whether there were too many or too few electrical connections, i.e. with respect to possible undesired interruptions or short circuits on the printed circuit board. Since the connection points of the printed circuit boards (that is the above-mentioned test points) were becoming increasingly close owing to the increasing miniaturization of the electronic components, in the past there were increasing difficulties in connecting the test or connection points of the test sample to the printed circuit board test apparatus, i.e. in adapting the test samples using increasingly complex adapters.

In the past various adaptation techniques were used for testing unequipped printed circuit boards/circuit carriers/ceramic substrates, the structure of a test probe adapter for example being a considerable factor in the total costs of the printed circuit board test procedure in particular if there was a relatively large number of test

points on the test sample. In principle a special adapter always had to be manufactured for a type or series of printed circuit boards to be tested which could not therefore be used for other series of printed circuit boards. Test probe adapters of this type were distinguished in that the test probes provided therein connected the regularly disposed contact points of the test apparatus to the irregularly disposed test points of the test sample. Since by nature the test points of each series of printed circuit board to be tested were distributed differently, a particular test adapter could not be used for other test samples, as stated above. In addition a test probe adapter of this type always had to be constructed in such a way that one test probe had to be available for each individual test point, which led to considerable problems concerning space and to limits being placed on the ability to be tested of printed circuit boards using so-called universal adapters as the density of test points on the test sample increased. In addition the increasing complexity of these test probe adapters and the sometimes very high number of test probes required gave rise to considerable problems with costs in the case of small series of printed circuit boards.

In order for it still to be possible to test competitively with small series of unequipped printed circuit boards to be tested, so-called flying probe test apparatus were developed, i.e. printed circuit board test apparatus with few (usually two) test probes which were moved to and fro in a computer-controlled manner parallel to the plane of the printed circuit board to be tested in order to contact selected test points in each case (usually two points simultaneously) and investigate for undesired interruptions or short circuits. If there are numerous test points on a test sample, these flying probe testers reach their limits very rapidly if each point is to be tested with respect to the others for short circuits/interruptions since point-to-point tests of this type can take up an extraordinarily great amount of time in view of

the large number. Therefore with flying probe testers of this type the tendency is towards other testing and measuring procedures which ultimately only provide a degree of probability which is high to a greater or lesser extent for regularly constructed printed circuit boards.

In the case of equipped printed circuit boards, i.e. finished electronic modules, so-called "in-circuit" testers are used for testing them, which testers, although they do not have to cope with the large number of test points to be tested with respect to each other as in the testing of unequipped printed circuit boards, do have to have a quite particular construction in order to be adapted to the requirements of finished electronic components of this type which leads to very high costs for the connection devices/adapters of in-circuit testers of this type.

Viewed overall the possibility of a restricted standardization of these adapters has arisen for testing unequipped printed circuit boards using so-called universal adapters which was not however possible hitherto with the adapters for in-circuit testers. Accordingly the object of the present invention is to provide a connection device or adapter both for unequipped and equipped printed circuit boards to be tested which can be used for both types of test sample. Therefore a connection device is to be provided for unequipped and equipped circuit boards and similar circuit carriers which adapts itself to the respective test sample and thus can really be used universally for every test sample.

A device of this type for testing substantially flat circuit carriers which are unequipped or which are equipped with electronic components comprises a contact connection device with test needles, each test needle being provided in accordance with the invention with its own motor drive, i.e. mechanical, electrical, electromagnet or pneumatic drive, for setting the position of the tip of the test needle at any

point of a three-dimensional portion of space on the contact connection device ("dancing needles"). For this purpose each test needle for example can be disposed on its own platform which is constructed as a wobble plate and of which the position in space can be adjusted by a motor. The platform with the test needle projecting therefrom can also be suspended cardanically and the suspension system can be constructed such that it can be adjusted perpendicular to the plane of the platform.

Preferably the platform lies with the test needle projecting therefrom on three adjusting pins which are parallel to one another, which form the corners of a triangle and each of which *per se* is adjustable by motor in its longitudinal direction simultaneously or in succession, the platform thus constructed as a wobble plate being acted upon resiliently with respect to the adjusting pins by spring forces or the like. In this respect each adjusting pin can thus be allocated its own linear motor, or a single linear motor is provided which adjusts each of the three adjusting pins in succession. In a particularly advantageous manner the linear motors are disposed in the space between the adjusting pins and as necessary above one another in each case in order to adjust the adjusting pins. In this way each "test needle unit" consisting of test needle, associated wobble plate and motor drive disposed therebelow can be constructed with particularly small radial dimensions.

A plurality of these test needle units which can be adjusted and driven by motor is advantageously combined structurally to form a test needle module, i.e. approximately 16 test needle units of this type are combined in a module with 4 x 4 test needle units which results in 48 adjusting pins to be adjusted per module.

A fundamental embodiment of the present invention is described with reference to the attached drawings, in which:

Figure 1 shows a test needle unit schematically; and

Figure 2 shows schematically a rectangular contact connection panel of a printed circuit board test apparatus, not shown in further detail, consisting of 8 times 10 of these test needle units.

Figure 1 shows a diagram of a test needle unit having three adjusting pins 10, 12, 14 which are disposed parallel to one another at the corners of a triangle which lies in the plane of the platform 16. Associated with each adjusting pin 10, 12, 14 is a linear motor for vertically adjusting each adjusting pin in such a way that the position of the platform 16 in space is determined by the vertical position of the three adjusting pins 10, 12, 14 towards which the platform is drawn for example by a tension spring (not shown), for example by a helical spring acting centrally on the underside of the platform 16. On the top of the platform remote from the helical spring - which platform is preferably square but may have another suitable outline - a test needle 18, which is for example 80 mm long and pyramidal (or spear-like) for example, is secured in the centre perpendicular to the plate surface. Depending on the vertical position, set by motor, of the upper ends of the adjusting pins 10, 12, 14, the platform 16 and thus the tip of the test needle 18 adopt different pivot or vertical positions in space above the test needle unit, i.e. the tip of the test needle can be set at any point of a three-dimensional portion of space above and partially also laterally of the platform, the shape of this portion of space ultimately depending on the extent of the vertical adjustability of the three adjusting pins 10, 12, 14 and the geometric dimensions of the platform and the length of the test needle 18 which is if possible invariable.

The use of three adjusting pins is particularly preferred since the position of a plane in space (i.e. the platform 16) is clearly defined by three points (the upper end faces of the

adjusting pins on which the platform rests). On the other hand it is also conceivable for the platform or needle itself to be suspended cardanically and adjusted by motor and furthermore the length of the test needle to be designed such that it is adjustable, as a result of which a three-dimensional area above and partially laterally of the platform is then likewise attainable for the test needle tip.

It is readily possible also to embody the concept of test needles 18 which can be moved by motor in their longitudinal direction and pivoted in any direction transversely thereto in some other way for example by means of a conventional sliding guide for each test needle unit, which sliding guide extends vertical to the horizontal initial position of the platform 16 in order to adjust the vertical position of the platform on which the test needle 18 is then mounted so as to rotate about an axis extending vertical to the platform and to pivot about an axis extending parallel thereto. A three-dimensional portion of space above and partially laterally of the test needle platform can also be reached by the tip of the test needle unit by virtue of a test needle drive of this type.

In the currently preferred embodiment of a test needle unit of this type the three adjusting pins 10, 12, 14 are guided parallel to one another in suitable linear guides (e.g. plastics material slide bearings) in a plurality of guide plates which are at a vertical spacing from one another and are parallel to one another, one adjusting pin 10 engaging with its upper rounded end in a conical recess 11 in the underside of the platform whereby the platform is secured on the pin 10 transversely thereto but can nevertheless pivot in all directions about this recess 11.

As Figure 1 shows the point of contact of the three adjusting pins 10, 12, 14 lie on the platform 16 at the corners of a triangle, the next point of contact of the adjusting pin 12 in the clockwise direction starting from the conical recess 11 being a wedge-

shaped elongate recess 13 which is aligned relative to the recess 11; since the distance on the platform from the point of contact of the adjusting pin 10 to the point of contact of the adjusting pin 12 varies depending on the pivot position of the platform 16 in the form of a wobble plate, the lengths have to be compensated via the longitudinal extension of the wedge-shaped recess 13 in the underside of the platform 16, i. e. the point of contact of the adjusting pin 12 drifts depending on the pivot position of the platform 16 in view of the inability of 10 and 12 in Figure 1 to move radially to the lefthand side or righthand side. The third adjusting pin 14 is supported on the underside of the platform 16 on an offset intermediate plane 15 and the point of contact of 14 drifts - depending on the pivot position or position of the platform 16 - in space on a curved, self-contained path on the intermediate plane. Owing to the vertical position of the intermediate plane 15 the adjusting pins 10, 12, 14 act at approximately the same vertical level in the vicinity of the platform 16.

The platform 16 is acted upon in the direction of the upper ends of the adjusting pins 10, 12, 14 by a tension spring (not shown in greater detail) or the like which acts on the underside of the platform approximately centrally thereon in order thus to attain a precisely defined position of the platform in space according to the vertical position of the adjusting pins.

Disposed on the top of the platform is a test needle 18 which extends perpendicular thereto and which, as Figure 1 shows, can be pyramidal or actually needle-shaped for example. Owing to the above-mentioned particular adjustability of the platform 16 in various pivot and vertical positions as a result of the adjusting pins 10, 12, 14, the test needle 18 can be set at any point of a three-dimensional area which lies vertically above and partially also laterally of the platform 16 or of the entire test needle unit in order thus to contact

a test point in any position in the above-mentioned three-dimensional portion of space with the tip of the test needle.

In the present context there is no need to consider the type of electrical connection of the test needle to the test circuit of the conventional computer-controlled printed circuit board test apparatus, not shown in the drawing, or of an "in-circuit" tester. It is familiar to the person skilled in the art of test apparatus for equipped or unequipped printed circuit boards and is furthermore only of minor importance in the present context.

Each of the three adjusting pins 10, 12, 14 of a test needle unit is set vertically for example by means of an associated linear motor in each case, i.e. a total of three motors which are disposed above one another in the area below the platform 16 in each case and between the three adjusting pins, i.e. the adjusting pins run past the motors externally and the respective motor is associated with the associated adjusting pin by means of suitable force-transmission mechanisms. However it is also possible to provide only one common (linear) motor for all three adjusting pins which motor then adjusts the three adjusting pins in succession by means of suitable coupling mechanisms in order to attain the desired position of the platform 16 in space and thus the necessary position of the test needle 18.

In a preferred embodiment of a test apparatus for equipped or unequipped printed circuit boards, 16 test needle units of this type for example with square platforms (rectangular, triangular, hexagonal or other outlines of the platform are also possible) and test needles disposed thereon are combined to form "modules" which have a total of 16 test needle units of this type and which are in each case disposed in fours in the transverse and longitudinal directions. As a result thereof each module requires a total of 48 adjusting pins to

be controlled/set which occurs via a computer associated with the module.

Overall a typical tester provided with the connection device (adapter) according to the invention has 1500 of these test needles for example for each side of a test sample, i.e. in the case of a double-sided tester 2 x 1500 needles. If the test sample in this example has more than 1500 test or connection points per side then the entire test procedure (i.e. the testing of each point with respect to all the others) can be divided into a plurality of partial measurements (test cycles) in which different subsets of test points on the test sample are connected to contact points of the connection device in order thus to adapt the higher connection density of the connection device, i.e. to the number of test needles (see Claim 2). The number of measuring possibilities does not increase linearly but quadratically with the number of test needles when it is a matter of point-to-point testing for short circuits/interruptions.

Depending on its complexity, the assembly of a conventional test probe adapter lasts for approximately 1 to 4 hours or more. On the other hand a connection device/adapter according to the present invention enables 50 test samples for example to be tested per hour without an adapter having to be constructed since each of the test needles can be set by motor at the position of the connection points to be tested on the printed circuit board by a suitable computer-control system. Therefore the limit of use for (test probe) adapters alters approximately to the batch size range of approximately 250 boards, i.e. with less than 250 printed circuit boards to be tested the expenditure on producing an adapter is greater than the computing time or testing time on a printed circuit board test apparatus.

Since each test needle can be set individually by motor, namely in steps of a few micrometres, an in-circuit tester

which only requires far fewer connection points for printed circuit boards equipped with electronic components can also be connected to this connection device according to the invention. In principle the connection device according to the invention can be regarded as a "universally adjustable interface" for the most widely varying types of electronic components.

For the successful testing of printed circuit boards or for the proper connection of a test apparatus to a test sample it is indispensable for it to be possible for two test points which are situated very close to one another to be reached by the test needles, i.e. each test needle unit must be able to reach into the partial area, on a test sample, associated with an immediately adjacent test needle unit by a distance which is large to a greater or lesser extent. Each test needle unit must therefore be able to reach not only the partial area of a cellular surface division pattern (e.g. triangular, rectangular, hexagonal or the like) associated with the unit itself but also a sufficiently large partial area of the cellular surface division areas associated with the adjacent test needles (cf. Claim 3).

In conjunction with the structure of a connection device (as shown in Figure 2) consisting of a plurality of test needle units of this type (Figure 1) it is readily possible to replace one or more test needle units by so-called special function modules, i.e. assemblies which assume tasks or functions other than the pure contacting of test points, i.e. a print module which marks a test sample recognized as being faulty by printing or stamping on corresponding information or a securing module which is equipped for example with rigid pilot pins in order to secure the respective test sample in the measuring position in which it is contacted by the test needle units. The special function modules can also assume other tasks such as the mechanical delivery and removal of

test samples or the optical measurement of the test sample in the test station.

CLAIMS

1. Device for testing substantially flat circuit carriers (printed circuit boards/ceramic substrates) which are unequipped or which are equipped with electronic components, having at least one connection device (adapter) which is necessary for adaptation to the test sample and which connects a plurality of connection points present in the device to a plurality of contact points which vary geometrically according to the test sample, characterized in that the connection device adapts itself to the respective test sample by mechanical devices and can thus be used universally for any test sample.

2. Device according to Claim 1, characterized in that the entire test procedure is divided into a plurality of partial measurements (test cycles) in which different subsets of contact points on the test sample are connected to contact points of the connection device in order to adapt possible higher connection densities of the test sample to the connection density of the connection device.

3. Device according to Claim 1 or 2, characterized in that disposed in the connection device in partial areas or in the total area of a cellular surface division pattern are contact needles which can be moved by controllable mechanical adjusting devices such that they can reach any point of a partial area of a test sample surface on one side of the test sample in each case; and in that the partial area of the surface of a test sample to be reached by a contact needle is determined by a geometrical relationship to the cell of the surface division pattern with which this contact needle is associated.

4. Device according to any one of Claims 1 to 3, characterized in that a regular grid of triangles is used as the surface division pattern.

5. Device according to any one of Claims 1 to 3, characterized in that a regular grid of rectangles is used as the surface division pattern.

6. Device according to any one of Claims 1 to 3, characterized in that a regular grid of hexagons is used as the surface division pattern.

7. Device according to Claims 1 to 6, characterized in that the connection device (s) is (are) divided into function modules which substantially do not overlap each other and which can therefore be aligned and with which one or more surface division patterns are associated in each case.

8. Device according to Claim 7, characterized in that the function modules can be removed and inserted at another point of the basic surface division pattern for servicing purposes or for adaptation to the outer contour of the test sample.

9. Device according to Claim 8, characterized in that function modules with different metrological functional scopes are used; and in that the geometric shape is selected such that they can be interchanged with one another, if necessary a plurality of function modules with different metrological functional scopes being used; and in that the geometric shape is selected such that they can be interchanged with one another, it being if necessary possible for a plurality of function modules of specific metrological functional scope to be exchanged for a different number of modules with different metrological functional scopes.

10. Device according to Claim 8 or 9, characterized in that at least one function module with a special mechanical functional scope is used which either makes these special mechanical functions available in addition to its metrological functional scope or has special mechanical functions exclusively and which occupies the place of one or more electronic function modules.

11. Device according to Claim 10, characterized in that at least one function module is used which enables the test sample to be secured mechanically at a fixed position or in a position which is automatically adjustable within a local area.

12. Device according to Claim 10, characterized in that at least one function module is used which enables the conductive pattern on the side of the test sample facing the universal connection device to be measured optically or electronically in order to take account of the offset or distortion values, obtained from the measurement, when the test needles are positioned, when the connection points on the test sample are contacted.

13. Device according to Claim 10, characterized in that at least one function module is used which assists an automatic delivery or removal of the test samples within the area covered by the connection device.

14. Device according to Claim 10, characterized in that at least one function module is used which enables fault-free and/or faulty test samples or partial test samples advantageously produced jointly to be marked automatically.

15. Device according to Claim 10, characterized in that at least one function module is replaced by a wildcard ("dummy") of which the task exclusively resides in

completing the connection device geometrically in its surface division pattern or stabilizing it mechanically.

16. Device according to any one of Claims 1 to 15, characterized in that a cell base predetermined by the surface division pattern is associated with each movable contact needle; and in that the connection area on the test sample surface associated with a needle consists of its own cell base and of parts of the cell base of the geometrically adjacent test needle .

17. Device according to Claims 1 to 16, characterized in that the contact needles are resilient in order to be able to control easily the forces generated by the plurality of contact needles.

18. Device according to Claims 1 to 16, characterized in that the pressure force of the individual contact needles is controlled by electromechanical devices.

19. Device according to any one of Claims 1 to 18, characterized in that the contact needles in operation are brought into contact with the test sample substantially in synchronous (i.e. simultaneous) contacting cycles.

20. Device according to Claims 1 to 19, characterized in that the pressure force occurring during contacting is absorbed by a support device mounted on the side of the test sample opposite the connection device.

21. Device according to Claim 20, characterized in that the support device dissipates the force from the test sample by means of needle-like support elements which are distributed over the surface of the test sample or support device.

22. Device according to Claim 20, characterized in that needle-like support elements are used which can be positioned in a similar manner to the contact needles of the connection device in order to be able to compensate any differences in thickness of components or connection elements of the test sample.

23. Device according to any one of Claims 20 to 22, characterized in that the entire connection device is movable perpendicular to the surface of the test sample.

24. Device, characterized in that a connection device claimed in Claims 1 to 19 is disposed on both sides of the test sample whereby both the simultaneous contacting on both sides is rendered possible and the dissipation of force by the symmetry of the distribution of the contact means is ensured.

25. Device according to Claim 24, characterized in that the connection needles which are possibly unnecessary in a given contacting cycle are brought into mechanical contact with the test sample for the symmetrical dissipation of force.

26. Device according to Claims 1 to 25, characterized in that the contact needles are in the form of a cone or pyramid or of a truncated cone or truncated pyramid.

27. Device according to Claims 1 to 26, characterized in that the contact needles consist of an elongate stabilizing base member with a contact element mounted therein/thereon.

28. Device according to Claim 27, characterized in that the contact element is resiliently suspended in order to generate a controlled pressure on the test sample.

29. Device according to Claims 1 to 28, characterized in that the contact needles are secured at their low ends so as to be optionally replaceable on a carrier member which determines the contact position of the needle at/on the test sample by its position or by its alignment.

30. Device according to Claim 29, characterized in that the carrier member is in the form of a vertically movable platform which can pivot to all sides.

31. Device according to Claim 29 or 30, characterized in that the carrier member is aligned by at least three substantially vertically movable supports.

32. Device according to Claim 29 or 30, characterized in that carrier member is aligned by four supports which are disposed in a rectangle and are substantially vertically movable.

33. Device according to Claims 1 to 29, characterized in that the contact needles are positioned by a combination of lifting, rotating and pivoting movements.

34. Device according to Claims 29 to 33, characterized in that at least one of the axial movements is controlled by a cam disc.

35. Device according to Claims 1 to 34, characterized in that the drive for positioning the contact needles is provided by stepper motors or brushless electronically commutated direct current motors in order to attain the necessary useful life.

36. Device according to Claims 1 to 34, characterized in that the drive for positioning the contact needles is provided by linear (voice-coil) motors.

37. Device according to Claims 1 to 36, characterized in that the alignment and drive for moving the contact needles are constructed so as to be mechanically independent of one another such that a plurality of adjusting shafts can be operated by a drive by means of mechanical devices, such as couplings for example, or adjusting shafts of a plurality of contact needles combined in a function module are moved by a drive.

38. Device according to any one of Claims 1 to 37, characterized in that the test samples can be delivered and/or removed automatically.

39. Device according to Claims 1 to 38, characterized in that the test samples are tested in a horizontal position.

40. Device according to Claims 1 to 38, characterized in that the test samples are tested in a vertical position.

41. Device according to Claims 1 to 40, characterized in that the connection device and support device or the connection devices on both sides can be swung out or displaced towards one another.

42. Device according to Claim 41, characterized in that the connection device (s) can be opened (semi-)automatically in order to facilitate the manual delivery of test samples or to provide space for the automatic delivery of necessary transport devices.

43. Device according to Claim 41 or 42, characterized in that at least two connection devices are used which can be used optionally opposite one another for contacting two different sides of a test sample or alternatively can be used on one side of the test sample by swinging out or rearrangement in conjunction with a support device according to Claims 20 to 23.

44. Device according to Claims 1 to 43, characterized in that the function modules are exchanged by means of an automatic delivery device in order to enable one type of test sample to be replaced fully automatically by the next without intervention on the part of the operating staff being necessary.

45. Device according to Claims 1 to 44, characterized in that the electronics required in order to attain the metrological functional scope are contained completely or partially in the function modules themselves.

46. Device according to Claims 1 to 44, characterized in that the electronics required in order to attain the metrological functional scope are disposed completely or partially externally of the function modules.

47. Device according to Claims 1 to 46, characterized in that central electronic components, such as the current supply or operating and control elements for example, jointly used by the function modules are accommodated in a separate unit.

48. Device according to Claims 1 to 47, characterized in that the electrical connection between the function modules and the external electrical components is provided by pluggable cable connections.

49. Device according to any one of Claims 1 to 48, characterized in that the electrical connection between the function modules and external electronic components is provided by means of one or more circuit carriers which are constructed in segment-like manner, which are provided with plug-in connectors and which if necessary are connected by pluggable cable connections to the external electronic components.

50. Device according to Claim 49, characterized in that a matrix-like control procedure is applied within circuit carriers used for connecting function modules to external electronic components.

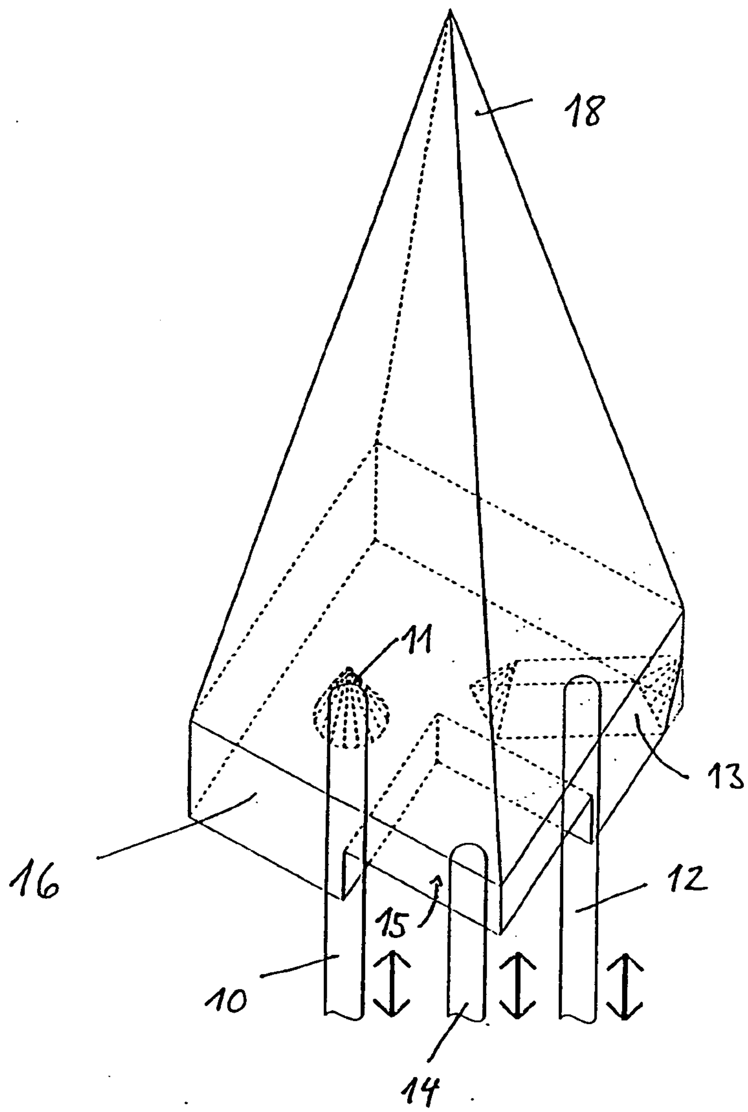


Fig. 1

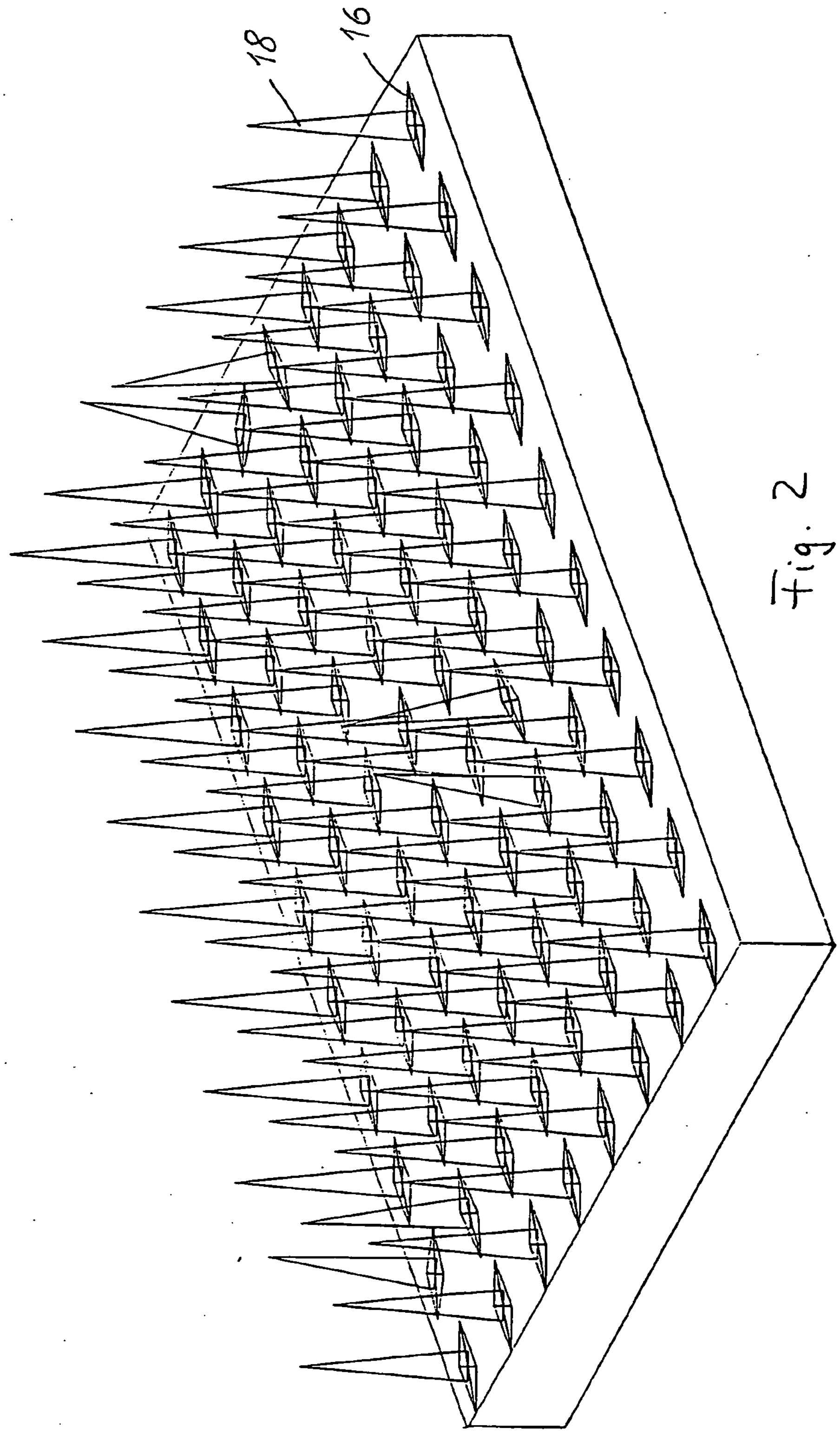


Fig. 2

INTERNATIONAL SEARCH REPORT

Interna   al Application No
PCT/EP 95/01562

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01R1/073

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 293 497 (IBM DEUTSCHLAND) 7 December 1988 see abstract see figure 5 ---	1,7-10
A	EP,A,0 468 153 (ATG) 29 January 1992 see claim 1; figure 1 ---	1
A	EP,A,0 458 280 (TESCON) 27 November 1991 see abstract -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 August 1995	29.08.95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Hoornaert, W

INTERNATIONAL SEARCH REPORT

Intern   ıal Application No
PCT/EP 95/01562

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